

"Digital Twins Longevity Assurance"



In today's digital age, digital twins have become essential tools for managing and optimizing physical assets throughout their lifecycle.

However, ensuring that these digital twins have the same longevity as the assets they represent poses technological, information governance, and software development challenges.

In this presentation, we will explore key solutions to ensure that digital twins can accompany their physical assets throughout their entire lifespan.



Project START

DIGITAL TWIN

ASSET'S LIFE CYCLE

DESIGN
1-2ys

CONSTRUCTION
2-3ys

OPERATION
75-100ys

Challenges in long-term Digital Twins



Closed Data Formats

Difficult long-term interoperability and risk information obsolescence if developers stop support.



Dependency on Proprietary Protocols

Makes them susceptible to changes or the discontinuation of the original providers, potentially leading to expensive reconfigurations or even data loss.



Short Lifecycle of Software Solutions

Contrasts with the long lifespan of many physical assets, posing a challenge to maintaining digital twins over time.

Solutions for long-term Digital Twins



Open Data Formats

Open, standardized data formats ensure digital twins' interoperability and longevity, enabling diverse tool access over time.



Open Protocols

Using standard protocols allows digital twins to integrate with various systems, reducing vendor dependence.



Open Software

Open-source software, maintained by a developer community, effectively extends system lifespan and ensures continuity, even without original developer support.

Open Data Formats

An open file format is a file format for storing digital data defined by an openly published specification usually maintained by a standards organization, and which can be used and implemented by anyone. An open file format is licensed with an open license.

▶ So that users might read my documents unhindered

Users exchanging reports.



CLOSED FORMAT, IDENTICAL SOFTWARE

Alice uses the software program "Carcera⁽¹⁾." She records her report in a closed format (one that does not permit interoperability), then sends it to Bob, who has the same software program. He can read the document, modify it and send it back to Alice.



PROGRAMS WITH CLOSED FORMATS, DIFFERENT SOFTWARE

The following day, Alice sends her report to Albert. He doesn't have the same software program, which refuses to open the document. Albert has no other choice than to acquire the Carcera software used by Alice, with the hope it is compatible with its computer.

So that your documents might be read more easily by other people, without you having to worry about which software they use, choose open formats.



PROGRAMS WITH OPEN FORMATS, DIFFERENT SOFTWARE

Carole, another user, chooses to record her report in open format (allowing for interoperability) and sends it to David. David can read the document, modify and record it, either by using the same open format software or by using another interoperable software.

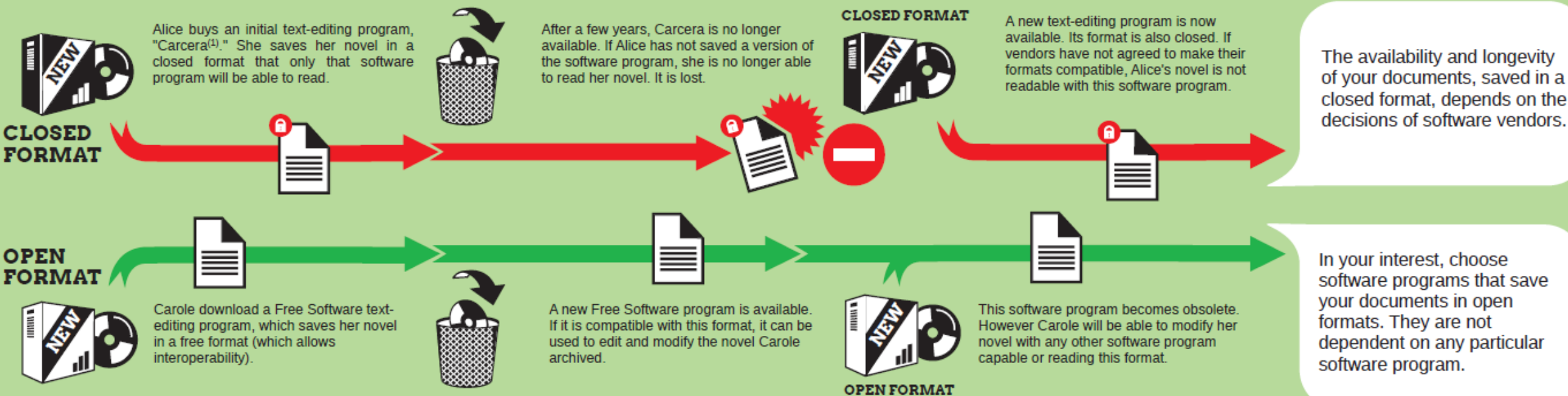
<https://www.april.org/en/open-formats>

Open Data Formats



▶ To ensure the longevity of my documents

Alice and Carole use text editors to write, save, and preserve a novel.



April To learn more, go to www.april.org. Documented created by April using Free Software. Design: Antoine Bardelli. License: Free Art License 1.3 or later / Creative Commons Attribution-ShareAlike 2.0 or later / GNU Free Documentation License 1.3 or later.
(1) Fictitious proprietary software program name, for illustration purposes.

<https://www.april.org/en/open-formats>

Open Data Formats

Properties

Basic Wall
 .Maó / Morter / Aill. / Aill. + Perfil. / 2
 Plaquas Guix 2.26.5

Walls (1) Edit Type

Constraints

Location Line	Finish Face: Exterior
Base Constraint	P1
Base Offset	-0.0700
Base is Attached	<input type="checkbox"/>
Base Extension Distance	0.0000
Top Constraint	Up to level: P2
Unconnected Height	3.5500
Top Offset	-0.0700
Top is Attached	<input type="checkbox"/>
Top Extension Distance	0.0000
Room Bounding	<input checked="" type="checkbox"/>
Related to Mass	<input type="checkbox"/>

Structural

Structural

Enable Analytical Model

Structural Usage Non-bearing

Dimensions

Length	1.9965
Area	7.558 m ²
Volume	1.868 m ³

Identity Data

Comments

Mark

Phasing

Phase Created Nueva construcción

Phase Demolished None

IFC Parameters

IfcGUID 2KjRuYApzCZRUIkWBX...

Other

In.Cat- Delimitador de ...

In.Cat- Structural

In.Cat- Base Level P1

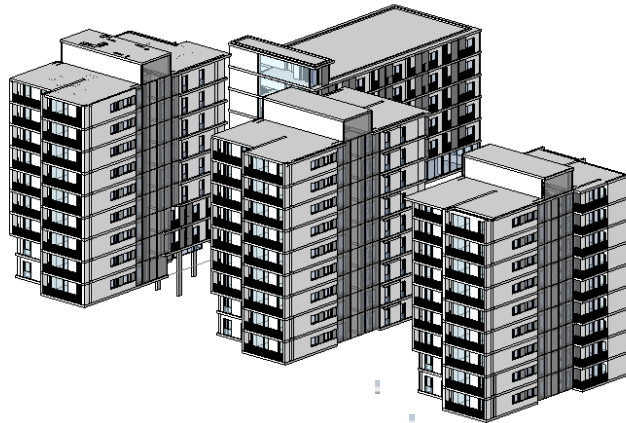
In.Cat- Top Level P2

In.Cat- Top Offset -0.0700

In.Cat- Height 3.5500

In.Cat- Base Offset -0.0700

Properties help Apply



Color: ■

ReferenceObject

GUID: 2KjRuYApzCZRUIkWBXcwx

File Format: ifc

Common Type: WallStandardCase

Geometric Classification: Solid

Volume: 1.9 m³

IfcRectangleProfile

Profile: Basic Wall. Maó / Morter / Aill. / Aill. +1

Dimension X: 2129 mm

Dimension Y: 265 mm

Ifc2X3Product

Product Name: Basic Wall. Maó / Morter / Aill. / Aill. +1

Product Description:

Product Object Type: Basic Wall. Maó / Morter / Aill. / Aill. +1

Owning User: @PMMT

Creation Date: 06/10/2014 6:28:04

Change Action: NoChange

State: Undefined

Application: Autodesk Revit 2014 (ENU) (Revit v2014)

IfcMaterialLayerSetUsage

Material Layer Set: Basic Wall. Maó / Morter / Aill. / Aill. +1

Material Direction: Aisl2

Material Direction Sense: Positive

Material Offset From Reference Line: -133 mm

Material Layer 1.Material: .Maó

Material Layer 1.Thickness: 113 mm

Material Layer 1.Ventilated: Unknown

Material Layer 2.Material: .Morter

Material Layer 2.Thickness: 16 mm

Material Layer 2.Ventilated: Unknown

Material Layer 3.Material: .Allament Termic

Material Layer 3.Thickness: 60 mm

Material Layer 4.Ventilated: Unknown

Material Layer 5.Material: .Placa Guix

Material Layer 5.Thickness: 15 mm

Material Layer 5.Ventilated: Unknown

Material Layer 6.Material: .Placa Guix

Material Layer 6.Thickness: 15 mm

Material Layer 6.Ventilated: Unknown

Structural

Enable Analytical Model: False

Structural: False

Structural Usage: Non-bearing

Phasing

Phase Created: Nueva construcción

Other

In.Cat- Base Level: P1

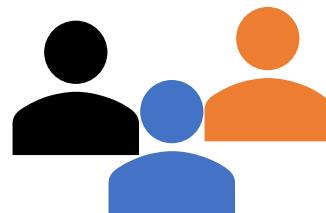
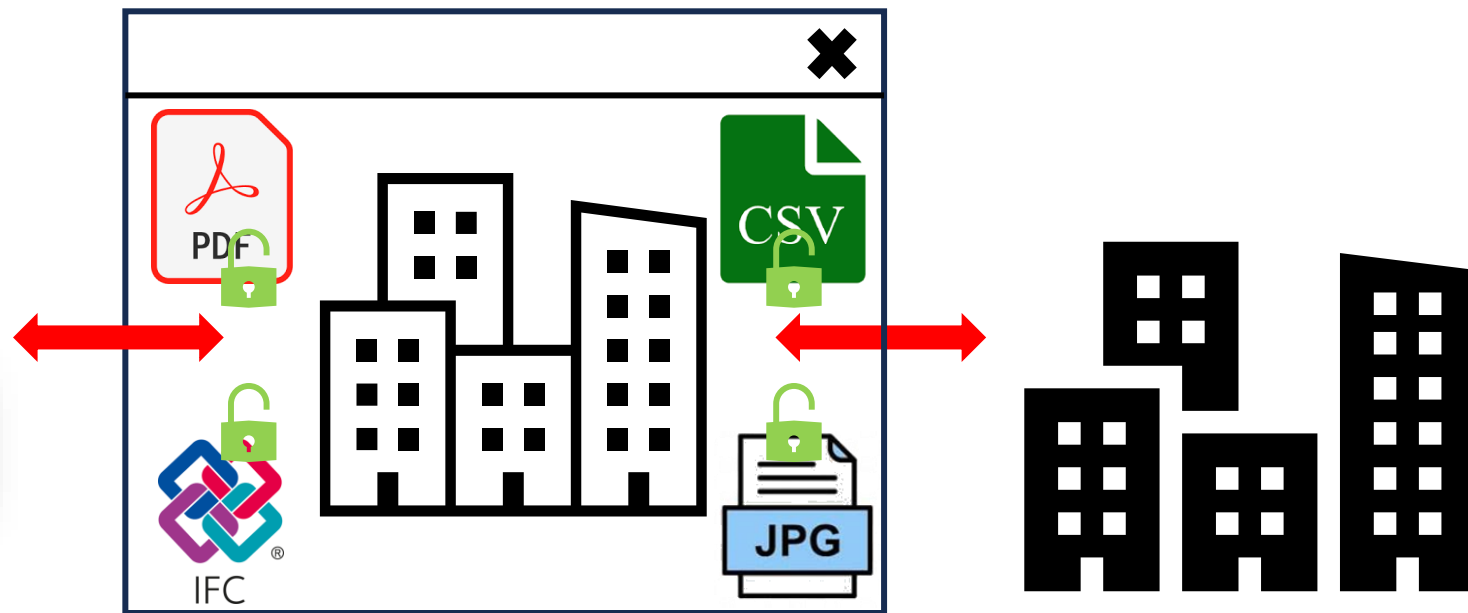
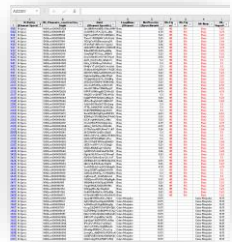
In.Cat- Base Offset: -70 mm

In.Cat- Delimitador de Recinte: True

In.Cat- Height: 3550 mm

In.Cat- Structural: False

Open Data Formats



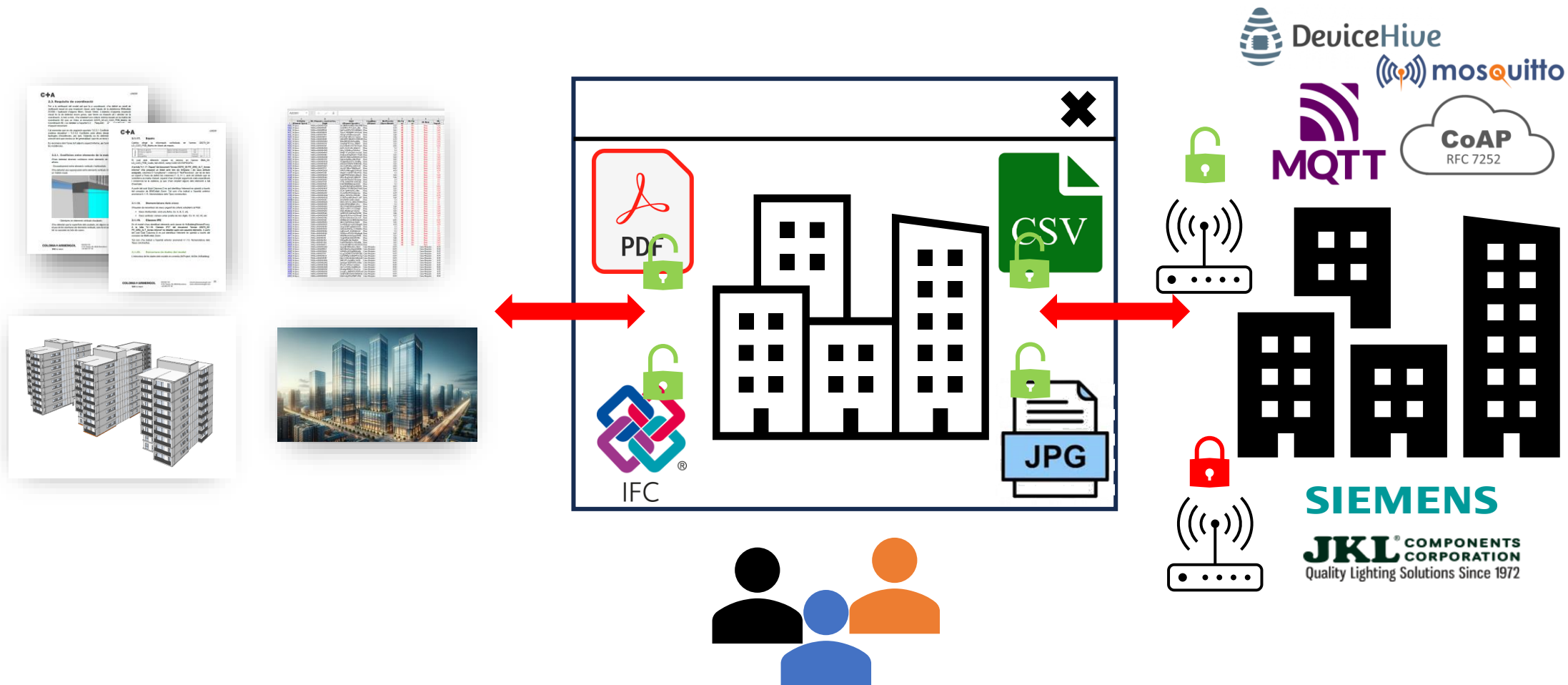
"Digital Twins Longevity Assurance"

Open Protocols

IoT Software Companies in 2023

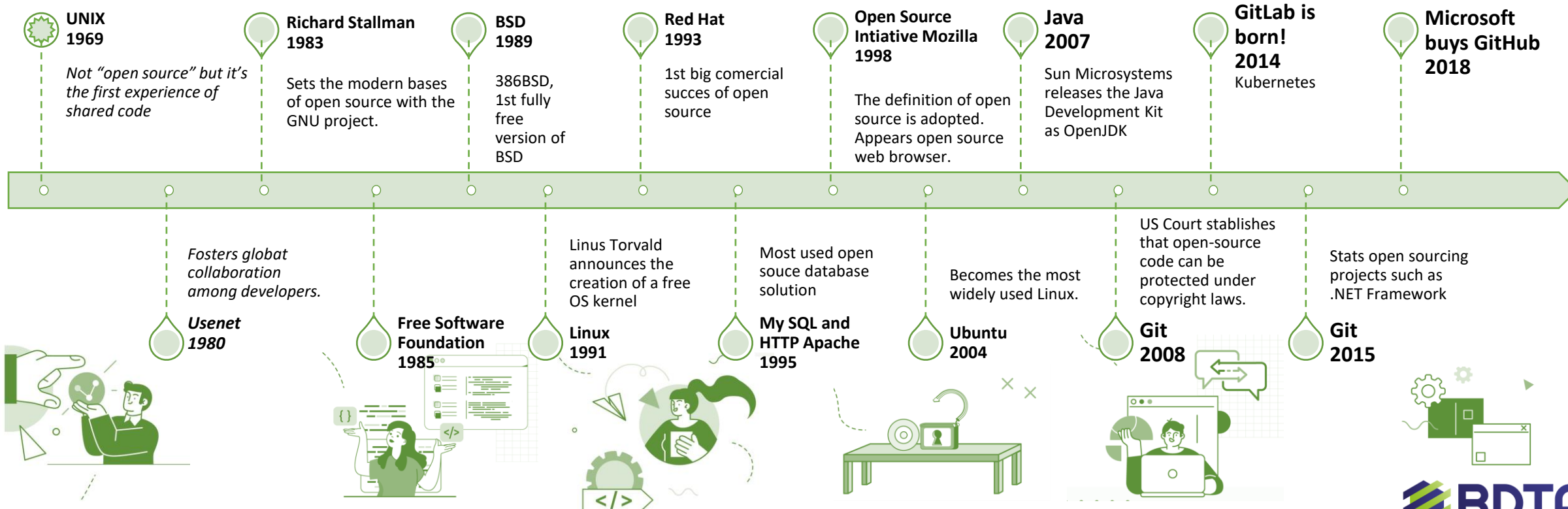
Applications² (selection only)	Remote Asset Access BELDEN intel ZOHIO aws CISCO ORACLE TeamViewer evatec jumpcloud. Pulseway AVEVA CONNECTWISE	AR/VR YORD Meta Apple iTechArt ptc WIR CXR REPLY Microsoft SAMSUNG HQ SOFTWARE	Digital Twin SIEMENS Microsoft aws Twinn anylogic celonis GE AUTODESK cadline CUPIX a VinZero company BUILD SMART	Security CISCO IBM aws paloalto NETWORKS Microsoft FORTINET praetorian AhnLab Symantec Endpoint Protection McAfee Bitdefender SUBEX
Middleware/Platforms	IoT Platforms Microsoft aws Honeywell Capgemini CISCO ptc Schneider dynamtrace Google Blynk Rockwell Automation ANDERSEN ADANTECH software AG SAP Telkom IoT TOPCON ORACLE AVEVA EMERSON IBM tcs TATA CONSULTANCY SERVICES beanTech WISE openremote infor ZEBRA salesforce Trimble BOSCH PARTICLE hakuna matata WellinTech	Edge Mgmt. Platforms SIEMENS aws IBM Microsoft CISCO AVEVA DELL aruba ALIZENT Schneider Electric Hewlett Packard Enterprise software AG EPICOR EQUINIX	Databases mongoDB aws SIEMENS Microsoft CISCO ORACLE APACHE osisoft CrateDB influxdb McObject kinetica salesforce IBM	Other IoT Middleware Microsoft ORACLE CISCO aws SAP IBM Informatica tuya MuleSoft DELL
Data ingestion tools Microsoft aws APACHE tamr THNGTRAX AUTODESK SIEMENS Qlik Adobe IBM snowflake inductive automation salesforce SAP	Msg. Brokers/Protocol Converters SIEMENS Microsoft ptc IBM aws RabbitMQ APACHE Honeywell Hivemq mosequito MuleSoft			
Devices/Edge	Operating system for IoT devices aws Microsoft IBM WNDVR Red Hat ORACLE CANONICAL Envision digital			

Open Protocols



Open Software

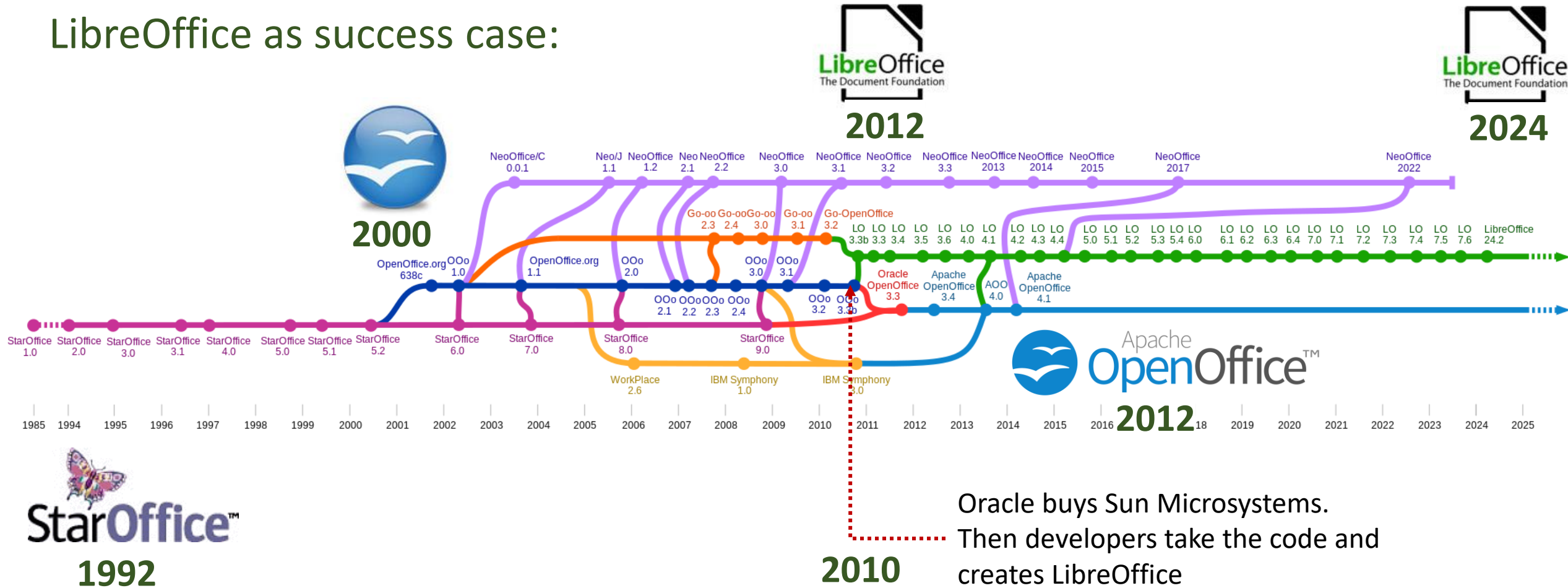
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Open Software

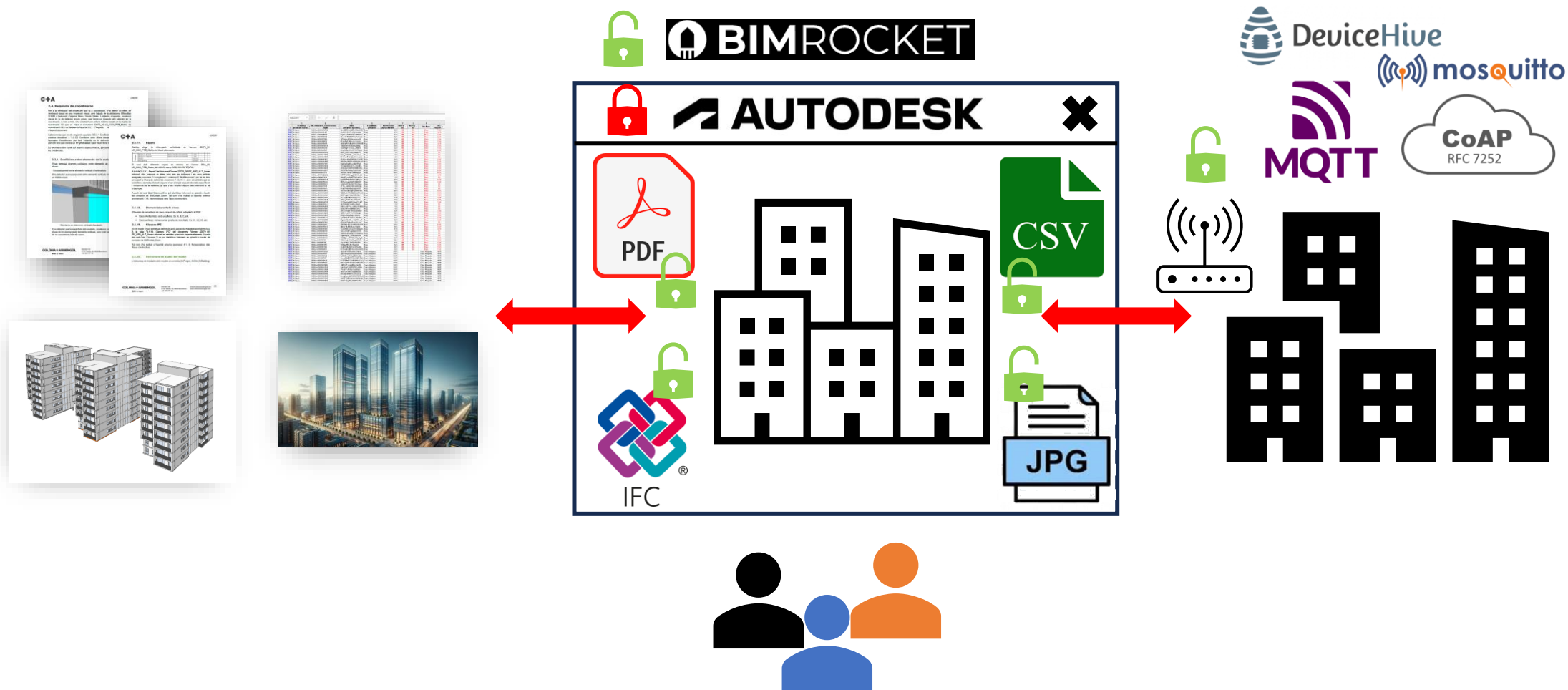
LibreOffice as success case:



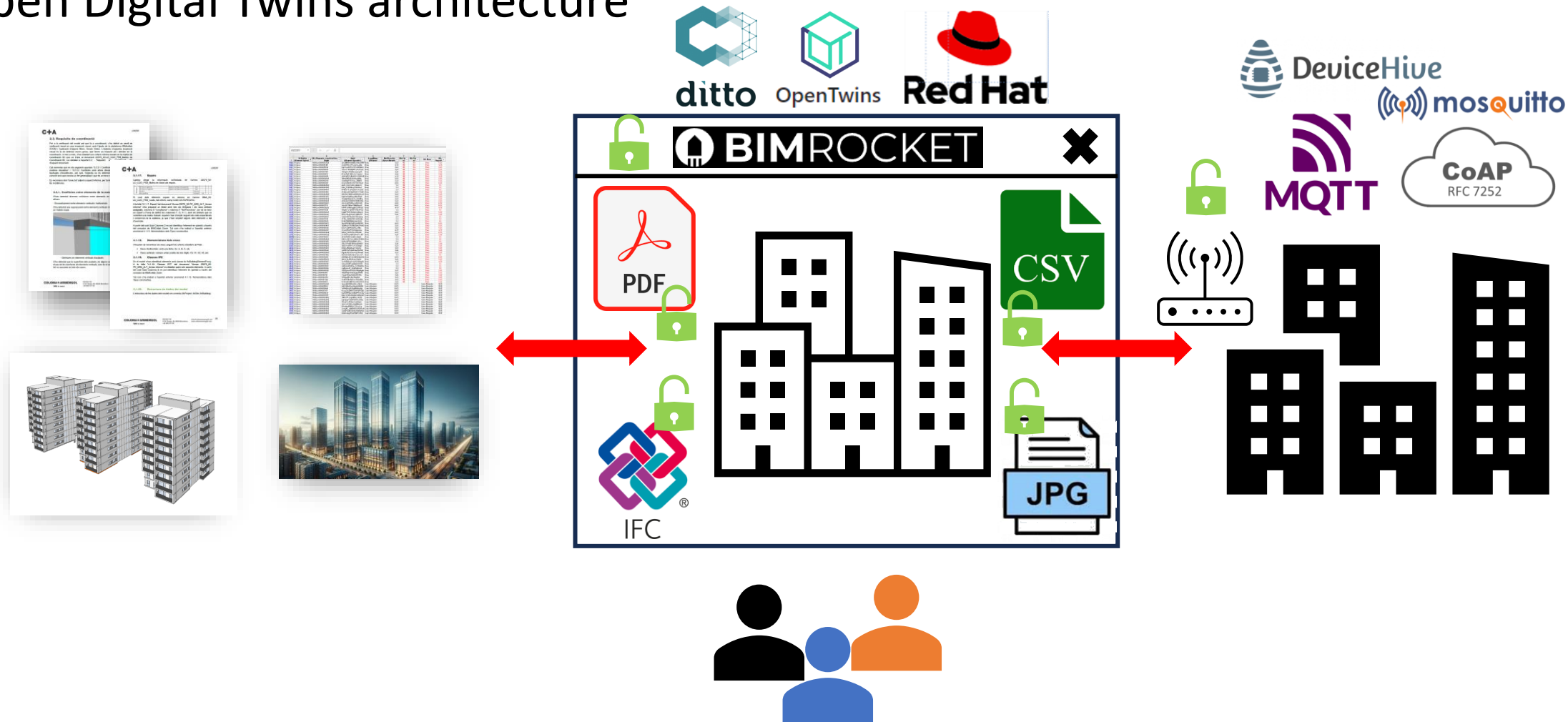
2010

Oracle buys Sun Microsystems.
Then developers take the code and creates LibreOffice

Open Software



Open Digital Twins architecture



Long-term Digital Twins strategy



Use Open Formats

Utilize standardized and interoperable data formats, such as IFC, FBX, and glTF, to store and share information of digital twins. This ensures that the **information can be accessed and processed by various tools over time.**



Use Standard Protocols

Adopt open communication protocols, such as OPC UA, MQTT, and BACnet, for integrating sensors, actuators, and other devices connected to digital twins. **This avoids dependence on proprietary solutions.**



Use Open-Source Software

Develop and utilize digital twin platforms based on open-source software, such as FreeCAD, BlenderBIM, or BIM Rocket. This ensures continuity and long-term support, even if the original developers discontinue maintenance. **Open-Source software assures the use of real standards.**



Benefits of the Open Digital Twins



Open Digital twins optimizes software maintenance and operation costs of physical assets throughout their lifecycle.



Open Digital twins allows availability of up-to-date and accurate software and contributes to more efficient asset and process management.



Open Digital Twins encourages collaboration among different software developers and main stakeholders.



Open Digital Twins Increases security Because all the community can examine the code. This empowerment helps prevent hidden vulnerabilities and backdoors.



Open Digital Twins increases code reliability by allowing improvements driven by one developer to be leveraged by the entire community.

Examples of long-term IT platforms in other sectors

Web Servers

In the world of information technology, web server software like Apache and Nginx have proven to maintain their functionality and relevance for decades, thanks to the adoption of open standards and community development.

Banking Systems

The computer systems that support banking operations are often designed to function for decades, with gradual updates and improvements. This is achieved through the use of open standards and robust information governance.

Aerospace Systems

In the aerospace sector, aircraft control and monitoring systems are designed to operate throughout the lifespan of the aircraft, using robust communication standards and data formats.

Railway Systems

Railway control and signaling systems are also characterized by their longevity, as they must operate reliably for decades. This is achieved through the adoption of sector-specific protocols and standards.

Towards an era of Open Digital Twins





4GH BUILDING DIGITAL TWIN
International Congress

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